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Original Research Article

Impact of Anesthesia on D-Dimer Concentration in Patients under Going Surgery Associated with High Risk for Pulmonary Embolism

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Abstract: ***Background:*** Pulmonary embolism (PE) is a blood clot that blocks and stops blood flow to an artery in the lung. It (PE) is a common and often fatal complication of venous thromboembolic disease (VTE). Pulmonary embolism (PE) is the third leading cause of cardiovascular-related death and is responsible for the hospitalization of a huge number of patients yearly. D-dimer concentration is a diagnostic marker of pulmonary embolism (PE). ***Aim of the study:*** This study aimed to assess the impact of anesthesia on D-dimer concentration in patients undergoing surgery associated with high risk for pulmonary embolism. ***Methods:*** This prospective observational study was conducted in the Department of Anesthesia & ICU, Mugda Medical College Hospital, Dhaka, Bangladesh during the period from *January 2022 to December 2022*. In total 57 patients undergoing surgery associated with a high risk for pulmonary embolism were enrolled in this study as study subjects. In this study, we examined the changes imparted by anaesthesia surgery on the end-tidal CO2/O2 compared with the D-dimer. Blood samples were immediately analyzed for fibrinogen and D-dimer concentrations. Breath samples were obtained from 1 min of spontaneous tidal breaths delivered via mouthpiece while the patientst breathed room air. ***Results:*** In this study, the mean transoperative value changes of respiratory rate (breaths/min), pulse rate (beats/min), systolic blood pressure (mmHg), SaO2 (%, room air) and minute ventilation (ml/min) were found as 0.23, 11.2, 15.33, 2.05 and 779.42 respectively. The pre-operative mean D-dimer 1042.57 ±202.47 ng/ml had been significantly increased to 1277.58 ±211.28 ng ml postoperatively, where the p-value was found as <0.001. On the other hand, the pre-operative mean End-tidal CO_2 / O_2, 0.3 ±0.02 had been decreased to 0.3 ±0.01 (Not significant). But the mean fibrinogen (mg/dl) had increased significantly (p<0.001). ***Conclusion:*** As per the findings of this study we can conclude that the stress impact of anaesthesia surgery causes less change in end-tidal CO2 / O2 compared with the D-dimer. We would like to recommend conducting similar more studies to determine if end-tidal CO2 / O2 can be used to monitor for postoperative pulmonary embolism (PE).

Keywords: Impact of anesthesia, D-dimer concentration, Surgery, Risk, Pulmonary embolism.

INTRODUCTION

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Pulmonary Embolism (PE) is a very common pathophysiological syndrome of pulmonary circulation disorders that may be caused by endogenous/exogenous pulmonary embolism blocking the main artery of the lung [1]. Pulmonary embolism (PE) is considered as the third leading cause of cardiovascular-related death and is responsible for the hospitalization of a huge number of patients yearly. Experts estimate that moderate to high-risk surgery carries a 2% to 10% rate of symptomatic postsurgical pulmonary embolism, even in the presence of thromboprophylaxis [2]. Postsurgical pulmonary embolism (PE) carries a 25% mortality rate-double the mortality rate of non-postoperative PE [3, 4]. One-half of postsurgical pulmonary embolisms (PE) occur after discharge from the hospital, making postsurgical pulmonary embolism a concern in the ambulatory and emergency department setting [5, 6]. The current mainstay of pulmonary vascular imaging for pulmonary embolisms, CT angiography, carries several risks to the postsurgical patient, including the indirect risk of contrast allergy, patient transport, radiation exposure, contrast nephropathy, and economic cost when the CT angiography shows no treatable condition [7]. Because of its high false-positive rate, D-dimer has little utility as a detecting tool in the immediate postsurgical period [8]. Likewise, measurement of the arterial blood partial pressures of oxygen (PaO_2), as well as carbon dioxide (PaCO2), seldom affects clinical decision-making in the evaluation of pulmonary embolism [9]. To reduce the technical trouble of detecting increased alveolar dead space, Kline and Hogg observed the exhaled end-tidal pCO2 ⁄ pO2 ratio as a surrogate for the dead space measurement [10]. The authors found that a very low pCO_2 / pO_2 ratio (<0Æ25) was strongly associated with the diagnosis of pulmonary embolism [11]. The major objective of this current study was to assess the impact of anesthesia on D-dimer concentration in patients undergoing surgery associated with high risk for pulmonary embolism.

METHODOLOGY

This prospective observational study was conducted in the Department of Anesthesia & ICU, Mugda Medical College Hospital, Dhaka, Bangladesh during the period from *January 2022 to December 2022*. In total 57 patients undergoing surgery associated with a high risk for pulmonary embolism were enrolled in this study as study subjects. The study was approved by the ethical committee of the mentioned hospital. Properly written consent was taken from all the patients before data collection. The whole intervention was conducted in accordance with the principles of human research specified in the Helsinki Declaration [12] and executed in compliance with currently applicable regulations and the provisions of the General Data Protection Regulation (GDPR) [13]. Properly written consent was taken from all the patients before data collection. In this study, we examined the changes imparted by anaesthesia surgery on the end-tidal CO_2/O_2 compared with the D-dimer. Blood samples were immediately analyzed for fibrinogen and D-dimer concentrations. Breath samples were obtained from 1 min of spontaneous tidal breaths delivered via mouthpiece while the patientst breathed room air. As per the exclusion criteria of this study, patients with an inability to breathe into a mouthpiece, diminished cognitive ability, venous thromboembolism diagnosed within the previous 6 months and the patients-reported reason that inferred a high probability that scheduled follow-up would be unsuccessful were excluded. After written informed consent, we obtained a specimen of citrate anticoagulated venous blood which was immediately analyzed for D-dimer concentration and fibrinogen concentration. Before surgery, a study coordinator met the patients and breath measurements were obtained. We used a proprietary commercial device that simultaneously measures volume, flow, air temperature, pCO_2 as well as pO_2 using mainstream gas sampling at 38°C. dead space volume was 60 ml. On the other hand, carbon dioxide was quantified by infrared absorption and oxygen by chemiluminescent quench detection. Breaths were collected until 10 (Ten) breaths satisfying these criteria were obtained. In analyzing the data, the null hypothesis stated that median percentage change in the pre- to postoperative end-tidal CO_2 / O_2 ratio would be no different compared with the trans-operative D-dimer concentration change using a Mann–Whitney U-test with P < 0Æ05 considered significant.

RESULTS

In this study, among the total patient, 61% were male whereas the rest 39% were female. So male patients were dominating in number and the male-female ratio of the patientsts was 1.6:1. The mean age of the respondents was 57.72 ±12.44 years. In more than two third of the patients (67%), lumber surgery and in one-fourth of the patients (25%), cervical surgery was performed. Among total patients, in 16%, 12% and 9% cases asthma, COPD and prior myocardial infarction were found respectively as comorbidities that were noticeable. Besides this, active malignancy, prior pulmonary embolism and prior DVT without pulmonary embolism were observed among 5%, 4% and 2% cases respectively. In this study, the mean trans operative value changes of respiratory rate (breaths/min), pulse rate (beats/min), systolic blood pressure (mmHg), SaO2 (%, room air) and minute ventilation (ml/min) were found as 0.23, 11.2, 15.33, 2.05 and 779.42 respectively. The pre-operative mean D-dimer 1042.57 ±202.47 ng/ml had been significantly increased to 1277.58 ±211.28 ng ml postoperatively, where the p-value was found as <0.001. On the other hand, the pre-operative mean ±SD End-tidal CO_2 / O_2, 0.3 ±0.02 had been decreased to 0.3 ±0.01 (Not significant). But the mean ±SD fibrinogen (mg/dl) had increased significantly (p<0.001).

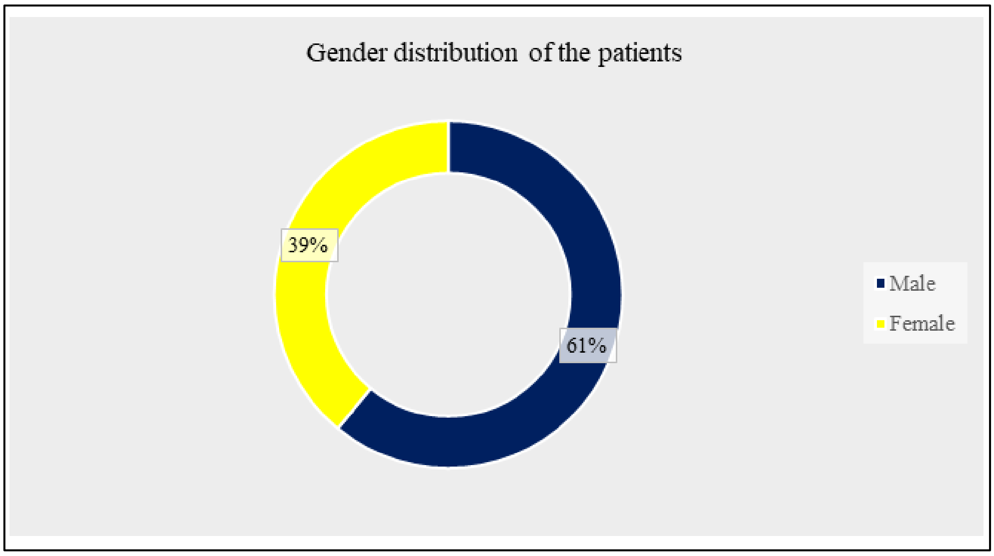

Figure I: Ring chart showed gender wise patient, (N=57)

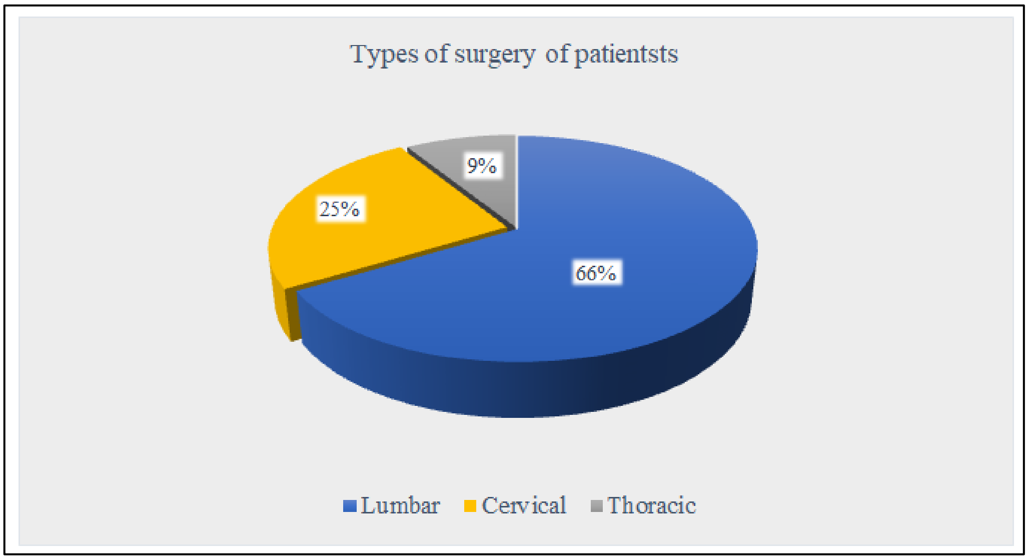

Figure II: Pie chart showed Distribution of patients as per types of surgery, (N=57)

Table 1: Distribution of patients as per comorbidities, (N=57)

Comorbidities	n	%
Asthma	9	16%
COPD	7	12%
Prior myocardial infarction	5	9%
Active malignancy	3	5%
Prior PE	2	4%
Prior DVT without PE	1	2%

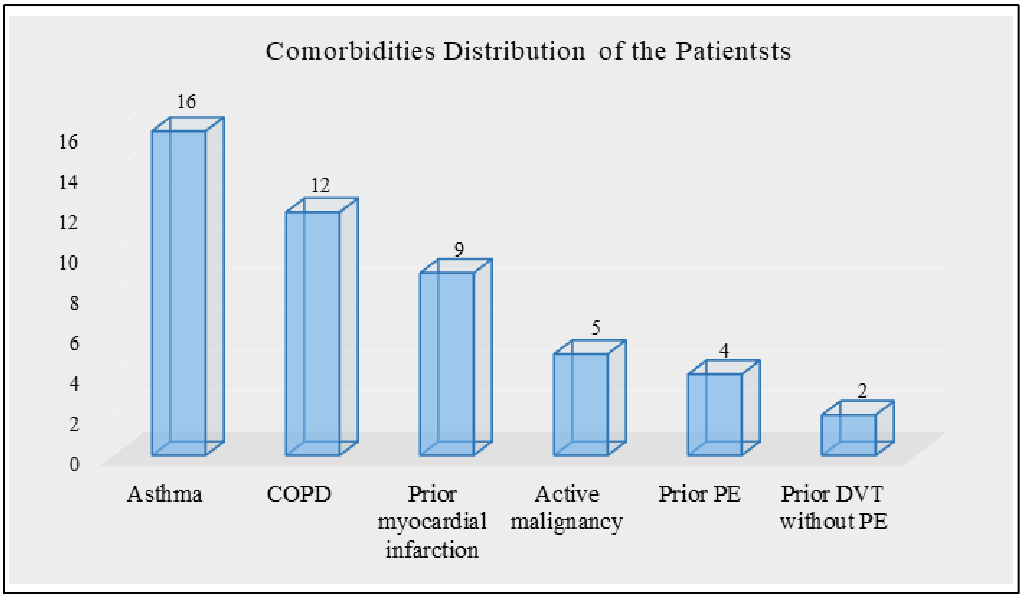

Figure III: Bar chart showed comorbidities wise patients, (N=57)

Table 2: Mean trans operative value changes of general parameters (N=57)

Variable	Preoperative	Postoperative	Mean changes
	Mean ±SD	Mean ±SD	
Respiratory rate (breaths/min)	18.12 ±1.53	17.89 ±1.79	0.23
Pulse rate (beats/min)	72.37 ±4.48	83.57 ±5.76	11.2
Systolic blood pressure (mmHg)	134.28 ±13.73	118.95 ±11.37	15.33
SaO_2 (%, room air)	98.33 ±1.26	96.28 ±1.18	2.05
Minute ventilation (ml/min)	9397.58 ±428.55	10177.16 ±488.69	779.42

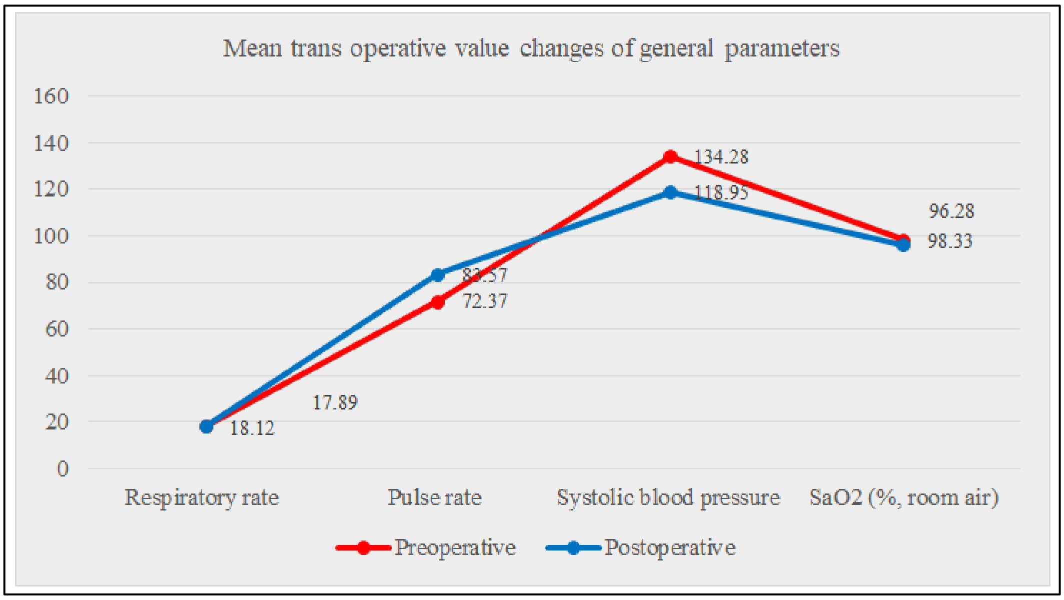

Figure IV: Line chart showed Mean trans operative value changes of general parameters, (N=57)

Table 3: Comparison $etCO_2$ etO_2, end-tidal CO_2/O_2, D-dimer and fibrinogen levels between pre and post-operative stages, (N=57)

Variable	Mean ±SD	Mean ±SD	P value
$etCO_2$ (%)	37.14 ±4.63	38.25 ±4.57	0.200
etO_2 (%)	122.19 ±12.77	123.28 ±12.69	0.649
End-tidal CO_2/O_2	0.3 ±0.02	0.3 ±0.01	1.000
D-dimer (ng/ml)	1042.57 ±202.47	1277.58 ±211.28	<0.001
Fibrinogen (mg/dl)	361.38 ±32.44	498.48 ±36.39	<0.001

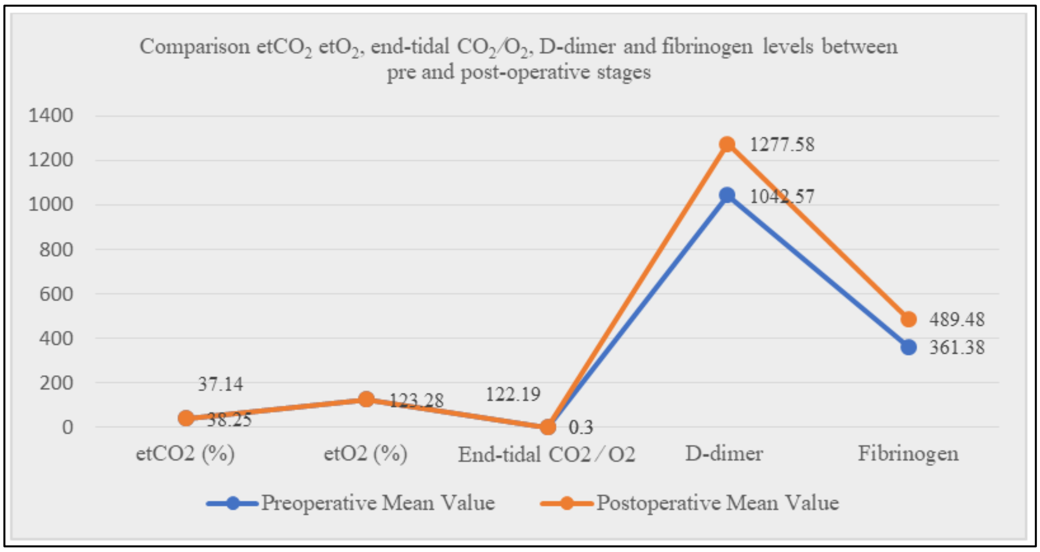

Figure V: Line chart showed Comparison etCO$_2$ etO$_2$, end-tidal CO$_2$/O$_2$, D-dimer and fibrinogen levels between pre and post-operative stages, (N=57)

DISCUSSION

This study aimed to assess the impact of anesthesia on D-dimer concentration patients undergoing surgery associated with high risk for pulmonary embolism. In this study, among the total patients, the male-female ratio of the patients was 1.6:1. The mean age of the respondents was 57.72 ±12.44 years. Among total patients, in 16%, 12% and 9% cases asthma, COPD and prior myocardial infarction were found respectively as comorbidities that were noticeable. All these findings are comparable with a previous study [10] In this study, the mean trans operative value changes of respiratory rate (breaths/min), pulse rate (beats/min), systolic blood pressure (mmHg), SaO$_2$ (%, room air) and minute ventilation (ml/min) were found as 0.23, 11.2, 15.33, 2.05 and 779.42 respectively. We performed this analysis following the procedures described previously by Kline *et al.*, 2006) [11]. Some of our findings were similar to their findings. The pre-operative mean ±SD D-dimer 1042.57 ±202.47 ng/ml had been significantly increased to 1277.58 ±211.28 ng ml postoperatively, where the p-value was found as <0.001. In a previous study [10], they found the mean D-dimer concentration in these 69 PE+, postoperative patients to be 2210 ± 2654 ng/ml. On the other hand, the pre-operative mean ±SD End-tidal CO$_2$ / O$_2$, 0.3 ±0.02 had been decreased to 0.3 ±0.01 (Not significant). But the mean fibrinogen (mg/dl) had increased significantly (p<0.001). Although D-dimer levels in plasma have been shown to increase postoperatively [14], an optimum concentration level signifying a lower risk may fill the clinical role, ruling out venous thromboembolism [15]. It should be mentioned that evidence based on some previous studies indicates that, postoperative D-dimer tests may not be accurate in sensitivity and specificity [16, 17]. A previous study, conducted by Dindo *et al*., [18] reported that the optimal period for D-dimer tests during the postoperative period depended on the type, invasiveness as well as the duration of the operation. All the findings of this current study may be helpful in further similar studies.

LIMITATION OF THE STUDY

Though it was a single-centered study with small-sized samples and the study was conducted over a very short period. So, the findings of this study may not reflect the exact scenario of the whole country.

CONCLUSION & RECOMMENDATION

According to the findings of this study, we can conclude that the stress impact of anaesthesia surgery causes less change in end-tidal CO2 / O2 compared with the D-dimer. We would like to recommend conducting similar more studies to determine if end-tidal CO2 / O2 can be used to monitor for postoperative pulmonary embolism (PE). For getting more specific results further studies with larger-sized samples are needed.

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